Multiple Account Evaluation

Horne Lake Connector

Highway 19 to Highway 4
Via Horne Lake

Prepared for:

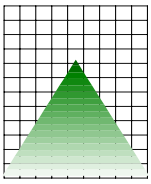
R.F. Binnie & Associates Ltd.
Parksville, BC

Prepared by:

Peter Lyall, P.Eng
Apex Engineering
Vancouver, BC

Project No. BIN-8
16 January, 2008

Apex Engineering Limited



Executive Summary

Horne Lake Connector

The project area is located on Vancouver Island north of Parksville and is a proposal for 20 km of new road linking the Island Highway at the existing Horne Lake Road intersection to Highway 4 east of Port Alberni. The intention is to provide a faster, safer connection for Port Alberni, Tofino and Ucluelet to the Island Highway and to improve reliability in the face of frequent closures on the existing route.

Short counts on Highway 4 range from about 6,000 to 11,000 AADT. The business case was prepared assuming different potential traffic diversion rates at 50% and 70% of the lower volume.

For South Island traffic, the proposed connector is a slightly longer route but has lower overall travel time, accident severity and rate associated with the combination of the Island Highway and the new connector. Traveled distance for North Island Traffic is reduced by 25.7 km, saving 18 minutes and reducing accidents through reduced exposure.

The project is viable from a benefit cost perspective, returning a B/C ratio of 1.5 at 50% traffic diversion and 2.1 at 70% diversion. Net Present Values are $17.3 and $34.6 million on an estimated $37.6 million cost.

Safety is the largest component of direct project benefits, saving an estimated 5.4 to 7.6 accidents per year. This project is unique in leveraging its safety benefit at no additional cost to the project by re-routing traffic onto the existing, safer Highway 19, the Island Highway; a high standard divided 4-lane facility with about 11,000 AADT.

Contents

1 Project Description 3
2 General Approach 4
3 Traffic 5
4 Multiple Account Evaluation 8
4.1 General approach 8
4.2 Financial Account 8
4.3 Customer Service Account 9
4.3.1 Safety 9
4.3.2 Mobility 10
4.3.3 Incident Delay 13
4.4 Environmental Account 14
4.5 Social Account 15
4.6 Economic Development Account 15
5 Multiple Account Evaluation Summary 16
6 Risk/Sensitivity Analysis 18
7 Project Implementation 18
8 Conclusions and Recommendations 19

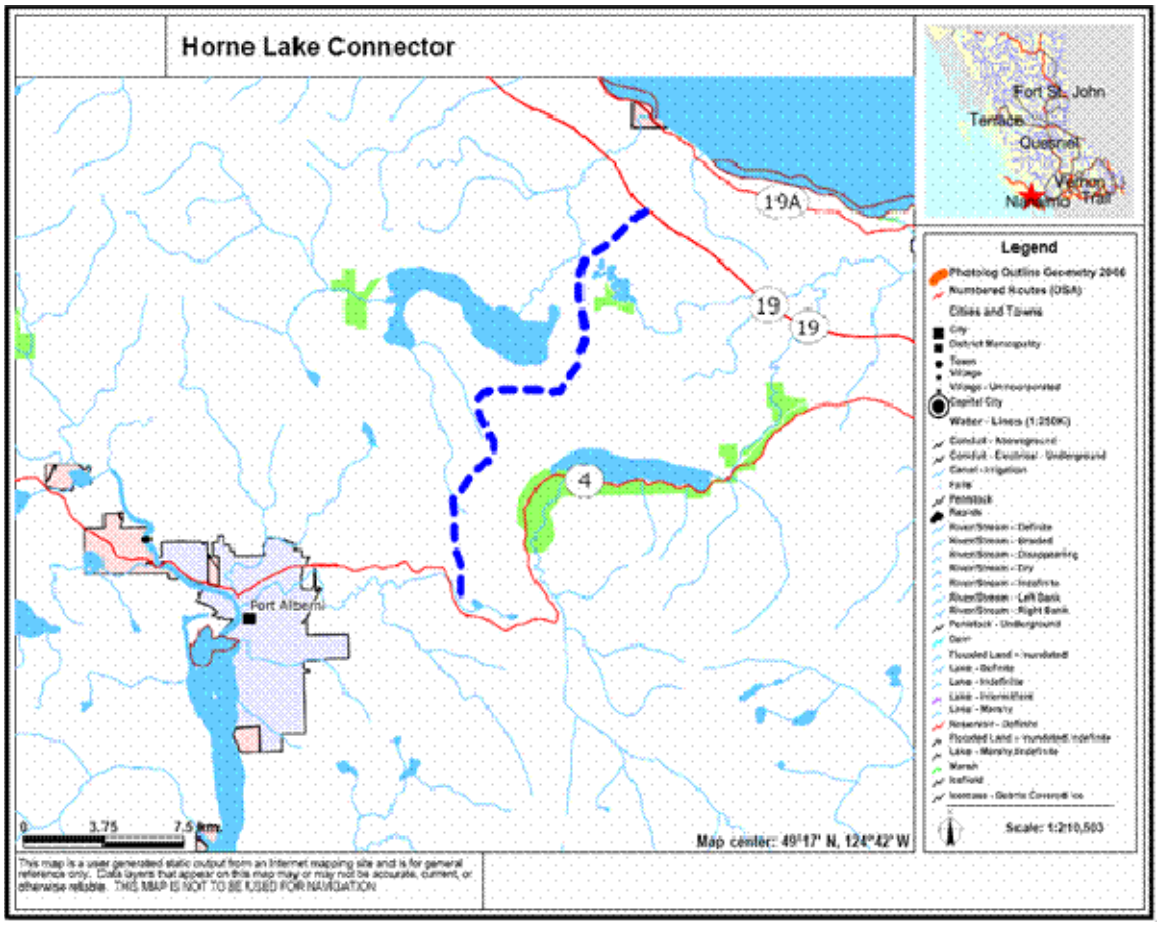
Exhibits

Exhibit 1-1 General Location 4
Exhibit 3-1 Traffic Assumptions 6
Exhibit 3-2 Historical and Projected Traffic 7
Exhibit 4-1 Capital Costs 8
Exhibit 4-2 Safety Performance 9
Exhibit 4-3 Traveled Distance 10
Exhibit 4-4 Travel Time and Speed Assumptions 12
Exhibit 4-5 Highway Closure Data 13
Exhibit 5-1 Multiple Account Evaluation 17
Exhibit 6-1 Sensitivity Analysis 18

1 Project Description

The Project area is located on Vancouver Island north of Parksville and is a proposal for 20 km of new road linking the Island Highway at the existing Horne Lake Road intersection to Highway 4 east of Port Alberni. The intention is to provide a faster, safer connection for Port Alberni, Tofino and Ucluelet to the Island Highway and to improve reliability in the face of frequent closures on the existing route. The Connector is shown conceptually in Exhibit 1-1.

Exhibit 1-1 General Location



Highway 4 is the primary link between Port Alberni/Tofino/Ucluelet and regional services and markets in Nanaimo and Parksville. Unscheduled closures due to weather or motor vehicle accidents effectively cut off these communities from the outside.

2 General Approach

The general approach is to analyse North and South Island traffic separately since the new connector impacts each traffic stream differently. The differences in travel time and distance are summarised in Exhibit 4-3 and Exhibit 4-4 and the safety performance in Exhibit 4-2.

South Island to Alberni Highway traffic is assumed to exit the Island Highway at the Highway 4 I/C, traveling west on Highway 4 through Hilliers and Whiskey Creek to Port Alberni. With the new connector in place, South Island traffic may continue north on the Island Highway past the Highway 4 I/C on to the Horne Lake Intersection and access the new connector. This route is about 3 km longer

but shortens travel time by 2 or 3 minutes due to the higher design standards and is safer overall.

North Island traffic now travels south on Highway 19 exiting at Highway 4 onto the Alberni Highway. With the new connector, North Island traffic would exit at Horne Lake Road onto the new connector shortening travel distance by over 25 km and 18 minutes.

3 Traffic

Four short counts have been taken in 1997, 2002, 2003 and 2006 at the Arrowsmith summit near the point where the proposed connector would join Highway 4 from the north. The counts range from 6,000 to 7,000 SADT. Calibrated to adjacent counts, the AADT is approximately 5,700.

For analysis purposes, this traffic is assumed to be:

- 5% local traffic, which is not subject to diversion to a new connector (Cathedral Grove traffic for example)
- 10% North Island traffic
- 85% South Island Traffic

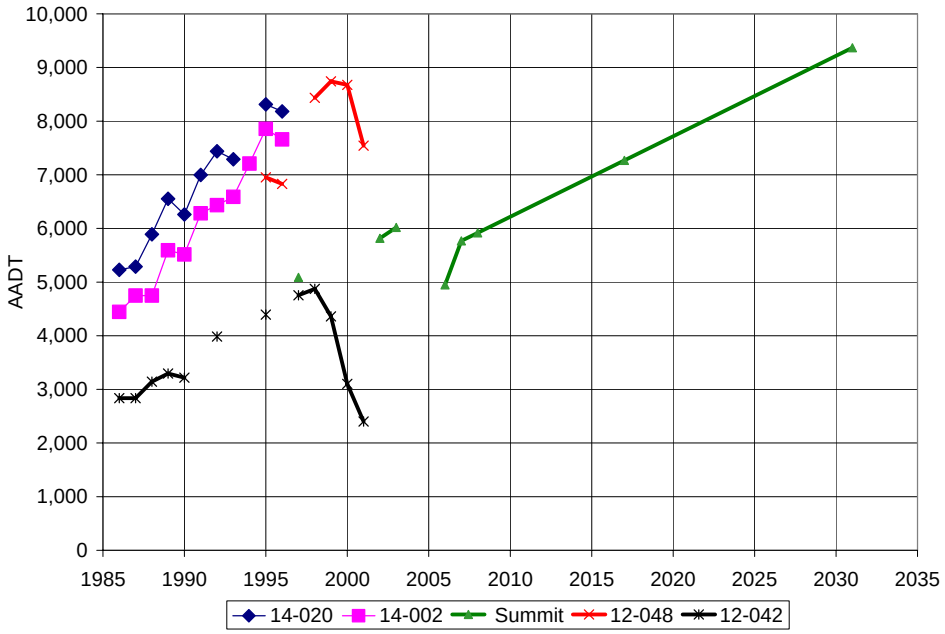
The north and south Island traffic is subject to diversion to the new connector. This business case tests the impact of capturing 50% or 70% of the through (non-local) traffic. This translates to roughly 2,700 or 3,800 AADT on the new connector. The capture rate and AADT assumptions are presented in Exhibit 3-1.

Exhibit 3-1 Traffic Assumptions

	Existing Rte Hwy 4	Proposed Horne Lake Connector 50% capture	Proposed Horne Lake Connector 70% capture
Traffic			
Counter	n/a		
Location	Arrowsmith Summit		
Last Count Yr.	2006		
Est 2007 AADT	**5,767**		
Split			
% Local Traffic	5%		
% North Island	10%		
% South Island	85%		
AADT = split x average			
Capture Rate	100%	60%	80%
Local Coombs Traffic	288	nil	nil
North Island	577	346	461
South Island	4,902	2,941	3,921
Total	5,767	3,287	4,383
Growth Rate	2.5%	2.5%	2.5%
% Trucks	10%	10%	10%

Historical and projected growth at these two count stations is presented in Exhibit 3-2. Historically, traffic has been growing at about 2.5%, which may reflect the influence of induced travel with the opening of the Island Highway. After 1999 there was a general decline in traffic volume evident at various counters between Hilliers and Port Alberni. This may be in response to a decline in activity at the Mill in Port Alberni and more broadly in forest products activity. Traffic will likely rebound and future demand growth is forecast at 2.5% per annum, but starting from a level below the historical trend line. Future population growth in Tofino/Ucluelet is forecast at 2.5% per annum.

Exhibit 3-2 Historical and Projected Traffic



Counter	Location
14-020	Hwy 4 W. of Hilliers Rd
14-002	Hwy 4 E. of Hilliers Rd
Summit	Hwy 4 Arrowsmith Summit
12-048	Hwy 4 E. of P. Alberni
12-042	Hwy 4 at Old Alberni Hwy

4 Multiple Account Evaluation

4.1 General approach

The project is evaluated in a multiple account framework, which includes financial, customer service, environmental, social and economic impact accounts. Most of the weight is given to the financial and customer service accounts since the social and environmental impacts are minor.

Benefits and costs are assessed as incremental to a base case, which assumes the existing highway continues in place. A 25-year horizon is assumed with a 6% discount rate. The direct benefits stemming from the project are primarily safety and travel time benefits. The costs evaluated include property, engineering, construction, operating and maintenance.

Benefits are evaluated separately for North and South Island traffic and then added together. Results are presented for 50% and 70% capture rates of existing traffic.

4.2 Financial Account

The financial account documents the capital and life cycle operating and maintenance costs. Exhibit 4-1 presents the capital cost assumptions used for analysis. Additional maintenance costs are assessed at $8,000/2-Ln-km for new route and $90,000/km for resurfacing every 15 years.

Exhibit 4-1 Capital Costs
($Millions 2007)

Property	$777,653
Engineering & Mgmt	$4,147,484
Reserve	
Construction	$32,661,435
Total	$37,586,572

4.3 Customer Service Account

4.3.1 Safety

The accident rates on Highway 4 and Highway 19 are based on 5 years of data from 2002 to 2006 inclusive. Within the study area, Highway 4 had 321 crashes (8 fatal) and Highway 19 had 101 crashes (1 fatal). The accident rate on Highway 4 in the study area at 0.64 acc/mvk compared to the Provincial average 0.50 acc/mvk for rural 2 lane arterials. The new connector is analysed assuming a Provincial average crash rate for a 2 lane rural arterial.

The observed and predicted safety performance is summarised below in Exhibit 4-2. The proposed connector has the potential to save 5.4 accidents/year at a 50% capture rate and 7.6 accidents/year at a 70% capture rate.

Accident severity and data by segment is presented in Appendix A..

Exhibit 4-2 Safety Performance

	Base	Proposed	Reduction
	Crash Rate (Acc/mvk)		
South Island Traffic	0.64	0.46	
North Island Traffic	0.57	0.50	
	50% Capture Rate		
	Exposure (mvk/yr)		
South Island Traffic	28.0	30.8	
North Island Traffic	4.8	2.1	
	Accidents/yr		
South Island Traffic	17.9	14.2	3.7
North Island Traffic	2.7	1.1	1.7
Total	20.7	15.2	5.4
	70% Capture Rate		
	Exposure (mvk/yr)		
South Island Traffic	39.2	43.1	
North Island Traffic	6.7	2.9	
	Accidents/yr		
South Island Traffic	25.1	19.9	5.2
North Island Traffic	3.8	1.5	2.3
Total	28.9	21.3	7.6

4.3.2 Mobility

Mobility assumptions are presented in Exhibit 4-3 and Exhibit 4-4. South Island traffic travels slightly further in the proposed case, but at a higher speed and overall travel time is reduced from 25 to 23 minutes. North Island travel time is reduced from 33 to 15 minutes and travel distance is reduced from 45.7 to 20 km.

Exhibit 4-3 Traveled Distance

	Existing	Via Horne Lake Connector
	South Island Traffic	
Segment	2356 (Hwy 4)	2353 (Hwy 19)
Start km	0.0	0.0
End km	2.6	14.4
Length (km)	2.6	14.4
Segment	2355 (Hwy 4)	New road
Start km	0.0	0.0
End km	28.7	20.0
Length (km)	28.7	20.0
Total Length (km)	31.30	34.40
	North Island Traffic	
Hwy 19 Segment	2353 (Hwy 19)	nil
Start km	25.7	
End km	40.1	
Length (km)	14.4	
Hwy 4 Segment	2356	nil
Start km	0.0	
End km	2.6	
Length (km)	2.6	
Hwy 4 Segment	2355	New road
Start km	0.0	0.0
End km	28.7	20.0
Length (km)	28.7	20.0
Total Length (km)	45.7	20.0

Exhibit 4-4 Travel Time and Speed Assumptions

Travel Speed & Time	**Existing Rte via Hwy 4**	**Via Horne Lake Connector**
	South Island Traffic	
Avg. Travel Speed (km/hr)		
Hwy 4	75.1	nil
Hwy 19	nil	108
Horne Lake Connector	nil	80
Rte Avg	75.1	91.7
Travel Time (minutes)		
Hwy 4	25.0	nil
Hwy 19	nil	8.0
Horne Lake Connector	nil	15.0
Total	25.0	23.0
	North Island Traffic	
Avg. Travel Speed (km/hr)		
Hwy 4	75.1	nil
Hwy 19	108	nil
Horne Lake Connector	nil	80
Rte Avg	85.5	80
Travel Time (minutes)		
Hwy 4	25.0	nil
Hwy 19	8.0	nil
Horne Lake Connector	nil	15.0
Total	33.0	15.0

4.3.3 Incident Delay

This is delay caused by scheduled or unscheduled incidents, which result in a highway closure. Within the 31.3 km study area of Highway 4, closure data recorded by DriveBC over the 21 months from 6 June, 2005 to 14 March, 2007, included 12 closures generally due to collisions, tree falls or weather.

Exhibit 4-5 Highway Closure Data

Number in 21 months	12
Total Hours	53.4
Average Hours/closure	4.5
Hr/100km/yr	97.6

Duration (hrs)	Date & Time	Type	Cause	Location
0.64	11/14/06 17:35	Planned	Maintenance	Cathedral Grove
3.63	11/14/06 18:57	Planned	Maintenance	Cathedral Grove
8.37	6/20/05 20:48	Incident	Collision	Ramps to and from Route 19, West of Parksville
6.80	11/29/05 10:05	Incident	Collision	Junction with Highway 4A
3.32	2/21/06 6:19	Incident	Collision	Junction with Highway 19
0.00	4/13/06 17:50	Incident	Livestock on Road	Cathedral Grove
2.50	11/4/06 20:27	Incident	Collision	Cathedral Grove
7.55	11/15/06 17:59	Incident	Debris on Road	Junction with Highway 4A
8.90	12/12/06 0:34	Incident	Heavy Rain and Wind	Port Alberni
8.34	12/12/06 0:43	Incident	Tree on Road	Port Alberni
3.05	2/28/07 18:27	Incident	Collision	Cathedral Grove
0.33	7/14/06 22:33	Incident	Collision	Coombs

When analysed in a queuing model, these closures generate 13,462 veh-hrs of delay per year. A commuter making 200 one-way trips has a 60% probability of encountering a queue and if a queue is encountered, the average delay is 2 hours and 25 minutes. A new route could potentially reduce this by 75%, saving

10,231 veh-hrs/yr with a present value over 25 years of $2.9 million. This is has been added to direct project benefits.

The study area has the equivalent of 97 hrs of closure/100 km/year. This appears initially to be well above the rate in other corridors shown below. This reflects a relatively small segment with high closure frequency. Taken at the corridor level comparable to other highways, the equivalent figures for the Alberni Highway from Highway 19 to Tofino are 104 hours of closure in 21 months over 164 km or the equivalent of 36.2 Hrs/100 km/yr. This is still moderately high for a highway of this traffic volume.

Corridor	***Hr/100km/yr***
Highway 4 – Hwy 19 to Tofino	36.2
Highway 97 Swan Lake to Monte Creek	4.1
Highway 16 Prince Rupert to Kitwanga	25.2
Highway 16 Kitwanga to Prince George	12.0
Highway 16 Prince George to Alberta	8.0
Highway 97 US Border to Kaleden	13.6
Highway 97 Kaleden to Westbank	20.8
Highway 97 Westbank to Swan Lake	60.6
Highway 99 Horseshoe Bay to Whistler	72.0

4.4 Environmental Account

Environmental impacts have not been assessed yet. The alignment generally follows existing roads from Highway 19 to Horne Lake and forest service roads to Highway 4, crossing 2 or 3 streams and following 8 or 9 km of shoreline along Horne Lake. Terrain is generally undeveloped forestlands and lowlands.

Impact categories include fish and fish habitat, wildlife habitat, ALR impacts, recreation and archeological impacts. The new alignment would be:

- Neutral with respect to fish habitat assuming full mitigation or compensation of impacts on the route.
- Slightly negative for wildlife as the connector will bisect previously intact habitat. Roads near water bodies such as Horne Lake also tend to have more animal/vehicle collisions as animals traverse the road to the water.
- Neutral with respect to ALR. The alignment does not traverse any ALR land with the exception of the existing Horne Lake Road adjacent to the Island Highway
- Recreation impacts are likely positive with the road providing better access to recreation around Horne Lake
- Archeological impacts are unknown
- Greenhouse gases - There is some reduction in fuel consumption due to the gentler terrain on the connector and the reduction in stopped delay. This is offset by the increased vehicle kilometers of travel and higher

travel speeds on the Island Highway/Connector. The overall impact is slightly negative.

4.5 Social Account

This option measure impacts to the surrounding community. In this case the project has strong support from communities west of the proposed connector. Highway 4 is the only connection to the regional airport in Nanaimo and to regional health services in Nanaimo. Fish products transported from the west coast on the Alberni Highway are particularly time sensitive and losses occur as a result of highway closures.

Other categories in this account include noise, visual, displacement and barrier effects of the highway project. These do not generally apply in this case as the connector is largely outside any developed area.

Diverting traffic away from Highway 4 through Whiskey Creek and Hilliers, would have some negative economic impacts identified in the next section. From a social perspective however, reduced traffic means less noise and a more pedestrian friendly environment. Traffic dependent business elements aside, this is a positive contribution to community values and liveability.

4.6 Economic Development Account

This account is intended to assess the broader economic impacts of a project beyond the immediate direct impacts to highway users. In this case the project supports the broader goal of improved access to the west coast of Vancouver Island along with the increasing interest in west coast recreational property and international and regional tourism. The highway provides access to the Pacific Rim National Park and Clayquot Sound recreational areas. Logging is in decline in this area but shellfish and aquaculture industries are increasing.

Locally, there are 10 to 20 highway-oriented businesses in Hilliers and Whiskey Creek, which would be bypassed by the connector. To the extent that they depend on drive-by traffic, their business will decline following the shift in traffic. Similar to Coombs, the typical outcome is a re-orientation of business towards more locally based or specific destination markets rather than a drive-by market base.

Offsetting the potential negative impact to business in Whiskey Creek and Hilliers are the benefits to businesses in Port Alberni and points west, of a more reliable highway connection to regional service centers in Parksville and Nanaimo.

5 Multiple Account Evaluation Summary

The results are presented in Exhibit 5-1. The project is viable from a benefit cost perspective. The direct benefits of the project exceed the direct costs.

The benefits stem from time and accident cost savings and are split about 60% to South Island and 40% North Island.

Timesavings to South Island traffic are about 2 min per vehicle in spite of a 3.1 km longer traveled distance by way of the new connector. The time saving stems from the higher operating speeds on the Island Highway and the new connector. North Island traffic benefits from a 25.7 km reduction in traveled distance from 45.7 km to 20.0 km and saves about 18 minutes. The low volume estimated at about 600 AADT offsets the large saving to North Island traffic. $2.9 million is added to timesavings in each case to account for reduced incident delay on Highway 4.

Accident Cost savings stem from both a reduction in accident severity and rate. South Island Traffic diverts from the 2 lane Highway 4 onto the 4 lane divided Island Highway and the new connector, both of which have lower severity and rate than the existing Highway 4. North Island traffic achieves accident reduction mostly through lower exposure due to the reduction in vehicle kilometers of travel by the shorter connector.

Reductions in vehicle operating costs are the third component evaluated for direct benefits. In this case, there is a net increase in both vehicle kilometers of travel and in the operating speed. Reduced cost to North Island traffic is offset by increases to South Island Traffic. While the new route has gentler terrain and reduced stop delay, the increased speed and distance contribute to an overall increase in fuel consumption and other vehicle costs. The net impact is minor but negative in this sub-account.

The costs include estimates of property, engineering and construction costs plus the present value of recurring maintenance and rehabilitation costs. The new road represents an incremental cost to the infrastructure provider.

Non-quantifiable impacts on the MAE chart are rated subjectively on a scale of -2 to +2 relative to current conditions without the project. This is normally done to allow comparison between alternatives. In this case, no alternatives have been proposed.

Exhibit 5-1 Multiple Account Evaluation

ACCOUNT		Diverted Traffic 50% Capture	Diverted Traffic 70% Capture
FINANCIAL		2007 Millions $	
	Discounted Cost	$35.5	$35.5
+	Maintenance & Rehab	$2.8	$2.8
-	Salvage	$6.3	$6.3
=	Present Value	$31.9	$31.9
CUSTOMER SERVICE		2007 Millions $	
	Time Savings	$24.2	$31.6
	Accident Savings	$27.9	$39.0
	Vehicle Operating Cost Savings	($2.9)	($4.0)
	Present Value	$49.2	$66.5
	Benefit/Cost Ratio	1.5	2.1
	Net Present Value	$17.3	$34.6
SOCIAL/COMMUNITY			
	Noise/Visual	0	0
	Displacement	0	0
	Barrier Effect	0	0
	Community Support	1	1
ENVIRONMENTAL			
	Fish and Fish Habitat	0	0
	Wildlife	-1	-1
	Agricultural Land Reserve	0	0
	Recreation	1	1
	Archeological	0	0
ECONOMIC			
	Local Business	0	0
	Provincial/National	1	1

Scoring	Relative to Existing
-2	Significantly worse
-1	Worse
0	Neutral
1	Better
2	Significantly better

6 Risk/Sensitivity Analysis

Exhibit 6-1 presents a sensitivity analysis of the results to changes in discount rate, construction cost and projected growth. In this case the project remains positive over the range of sensitivities tested.

Exhibit 6-1 Sensitivity Analysis

	Sensitivity Option						
	6% Discount Rate	4% Discount Rate	8% Discount Rate	+10% Construc-tion Cost	+25% Construc-tion Cost	Traffic Growth +0.5%	Traffic Growth -0.5%
	Net Present Value (millions $)						
50% Capture	14.4	13.6	11.6	10.6	5.0	7.0	6.0
70% Capture	31.7	48.1	19.8	27.9	22.3	35.3	28.4
	B/C Ratio						
50% Capture	1.5	1.4	1.4	1.3	1.2	1.2	1.2
70% Capture	2.0	2.5	1.6	1.9	1.7	2.1	1.9

The primary sensitivity tested is the assumed capture rate for traffic diverting to the new route. 50% and 70% are tested.

7 Project Implementation

The project is at the conceptual stage and no implementation plan has been developed yet.

8 Conclusions and Recommendations

The project returns positive economic benefits in the form of timesavings and accident reduction.

There are large time savings to North Island traffic since the new connector reduces traveled distance by 25.7 km and 18 minutes. This is offset by a lower volume on this direction of approach to the proposed connector, estimated at 577 AADT. For South Island traffic, the traveled distance increases slightly compared to the existing Highway 4 route but travel time declines slightly (3 minutes) due to the higher travel speeds on the Island Highway and new connector.

Safety is the largest component of user benefits. This project has a *unique characteristic of leveraging its safety benefit at no additional cost to the project by re-routing traffic onto the existing, safer Highway 19*. While the connector will have better safety performance than Highway 4, the leveraged benefits more than double the benefits of the connector alone. The combination of Highway 19/Connector has the potential to save an estimated 5.4 to 7.6 accidents per year depending on the rate of traffic diversion to the new connector. Accident savings to North Island traffic stem from a reduction in exposure while savings to south Island traffic stem from a reduction in severity and rate associated with the 4 lane divided Island Highway and the new connector alignment.

While the main impetus for this project is reliability, the determining factor in the benefit cost analysis is safety. From a benefit cost perspective, the project is feasible and returns a positive economic benefit. The Benefit Cost Ratio is 1.5 at 50% diversion and 2.1 at 70% diversion.

Cost Sharing

- Highway 4 is a designated National Highway System Feeder Route and may be eligible for cost sharing with the Federal Government under a Strategic Infrastructure Funding program.
- ICBC also has a cost-sharing program to the extent that their own analysis demonstrates a potential insurance cost saving.

Other options to the bypass should be identified and evaluated or explicitly ruled out if they are not feasible due to terrain or other limitations.

Appendix A
Accident Data

Observed Base Case
Accidents **2002 to 2006**

Highway 4 *(Existing S. Island Route)*				
Segment 2356 0.0-2.62	2.62			
Segment 2355 0.0-28.68	28.68			
Length (km)	31.30			
Service Class	RAU2			
AADT 10 yr Average	8,472			
Years	5			
Exposure (mvk)	484			
	Fat	Inj	PDO	All
Accidents	8	143	170	321
Observed Rate (a/mvk)	0.014	0.24	0.29	0.55
Severity	2.5%	44.5%	53.0%	100.0%

Highway 19				
NB Segment 2353 km 0.0-14.4	14.40			
SB Segment 2354 km 25.69 - 40.08	14.40			
Length (km)	14.40			
Service Class	RAD4			
AADT 10 yr Average	9,432			
Years	5			
Exposure (mvk)	248			
	Fat	Inj	PDO	All
Observed Accidents	1	38	62	101
Observed Rate (a/mvk)	0.0040	0.15	0.25	0.41
Rate Used for Analysis (acc/mvk)	0.0043	0.19	0.22	0.41
Provincial Avg. Severity	1.05%	45.5%	53.5%	100.0%

Estimated

Horne Lake Connector				
Length (km)	20.0			
Service Class	RAU2			
	Fat	Inj	PDO	All
Predicted Rate (a/mvk)	0.01	0.22	0.27	0.50
Severity	2.41%	43.5%	54.1%	100.0%

Combined Hwy 19/Highway 4 *(Existing N. Island Route)* Length (km)	45.7			
	Fat	Inj	PDO	All
Combined Rate (a/mvk)	0.01	0.25	0.30	0.57
Severity	2.23%	44.5%	53.3%	100.0%

Combined Hwy 19/Horne Lake Connector *(proposed S. Island Route)* Length (km)	34.4			
	Fat	Inj	PDO	All
Predicted Rate (a/mvk)	0.01	0.20	0.25	0.46
Severity	1.91%	44.2%	53.9%	100.0%